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SELECTIONS FROM THE RECORDS OF THE BOMBAY GOVERNMENT.

No. LXXXII.—New Series.

REPORT

ON THE QUESTION OF

IRRIGATION IN THE YERLA VALLEY.

WITH A MAP AND TEN PLANS, &C.

00105527

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Bombay:
PRINTED FOR GOVERNMENT
AT THE EDUCATION SOCIETY'S PRESS, BYCULLA

1864.

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ON THE QUESTION OF

IRRIGATION IN THE YERLA VALLEY.

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WITH A MAP AND TEN PLANS, &c.

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1864.

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No. 166 of 1863.

Public Works Department.

From the Assistant Superintending Engineer for Irrigation,

To the Superintending Engineer for Irrigation.

Sir,—In forwarding you the accompanying plans and estimates as per attached list, I have the honour to append an explanatory report on the question of Irrigation in the Yerla Valley.

2. Before proceeding to explain the project that I would propose for immediate execution, I will draw your attention to a more extended scheme for a system of irrigation that would provide for the wants of the greater part of the valley of the Yerla.

3. Your measurements of the volume of the river, as well as those made by me, established the fact that no more than ten cubic feet per second of hot-weather supply can safely be reckoned upon. It then became evident that some arrangement for extensive storage should be resorted to; and on making an examination of the country at the head of the river, I found a sufficiently favourable site for the construction of a storage lake.

4. Above the village of Neher the valley of the river narrows in till the hills approach to within about a mile of each other, and immediately above this point the basin widens out to a breadth of two and a half miles, while it stretches northward for upwards of three miles. Thus by throwing a bank having a mean height of 66 feet across the gorge, we would confine a sheet of water equal to $3\frac{3}{4}$ square miles, with a mean depth of 36·5 feet, and containing some 140,197,375 cubic yards of water.

5. The area of rainfall for the supply of the lake is about 62 square miles, and taking the average fall for five years, and assuming that one-fourth would be lost by absorption, we arrive at the conclusion that the proposed reservoir would contain the whole of the available rainfall of an average year. Assuming that eight feet depth over the whole reservoir were lost by evaporation, there would still remain sufficient for 20,000 acres of perennial irrigation.

6. The features of the country are in many respects favourable to the construction of a reservoir for storage. Two large nullas fall into the river immediately above the dam site, so that not only is the area of the lake very considerable, but the depth for a large portion of the area is beyond what that of tanks of equal area usually is. There is an ample supply of good soil for the construction of the dam close to where it is proposed to be placed.

7. To the east of the site of the embankment the ground is highly favourable for the position of a waste weir; it is of hard moorum, and is in the form of a shallow depression leading away from the dam, and ending in a wide nulla that would suffice to carry off all surplus water clear of the works, and finally lead it into the river opposite the village of Neher. An inspection of the lake plan will explain clearly the line of the ground.

8. For the distribution of the water it was proposed to establish four sets of works with channels leading off at both sides of the river (as shown on the attached sketch plan). It was intended that they should be situated at Neher, Khadgoon, Wankeshwur, and Nudwall, these places affording favourable sites for the erection of dams and regulating works.

9. With this in view I had the necessary levels taken, hoping to be able to lay the complete project before Government. Having, however, completed some of the drawings, and having made a sufficiently accurate estimate of the cost of the whole scheme to enable me to compare the result with the return, I found that the comparison was not so favourable as I had hoped and anticipated. The return in fact that might fairly be counted on would not represent a

sufficiently large percentage on the cost to justify the commencement of the work.

10. It would be necessary, in order to make the project sufficiently remunerative, either to reduce the dimensions and cost of the reservoir, or else to extend the area of land to be irrigated. If either expedient be adopted, I have no doubt that a successful issue will be arrived at. The latter alternative is the natural one, and that I would recommend. I intended indeed, if time had admitted of doing so, to carry all the lines of channel sufficiently far to embrace more country than the reservoir could possibly have served to irrigate, but this, I regret to say, circumstances prevented. I believe that it will be necessary to add to the present project one or two pairs of channels further down the valley.

11. Even if I could place the project in a sufficiently advantageous point of view, I fear that Government would be unwilling to sanction it as a whole. It would probably be objected to as absorbing more than a fair proportion of the outlay for the improvement of the country that Government are prepared to accord.

12. The project that I have now the honour to submit for your approval is simply a part of the whole scheme for the irrigation of the Yerla Valley, and carried out in its present form will need no modification when the time for construction of the reservoir and of the other distributing works on the river may arrive.

13. The work that I would propose for execution during the approaching season is the construction of a masonry dam across the river at Khadgoon, with a pair of distribution channels—that on the right bank (channel C) to be 9 miles long, and that on the left bank (channel D) $8\frac{1}{4}$ miles long. The country lying under the command of these channels amounts to about 20 square miles, and allowing that three-fourths of the whole were under irrigation, we would leave an acreage of 9,600 watered. The greater part (if not the whole) of the land is rich, black soil, but in many places, from its high position and consequent want of moisture, it is unproductive to a great degree. The remedy for this is of course to bring it under command of an unfailing supply of water, and secure a regular crop where the prospect was before doubtful.

14. The principal works are as follows:—

The Dam.

It will have a width of 4 feet on the top, increasing by offsets of 1 foot 3 inches in every foot and a half of depth, till at the greatest height the base will reach a width of 15 feet 3 inches. An average depth of foundation of 2 feet has been provided for in the estimate, but this is probably in excess, for the river-bed is of sound and compact rock. It is well, however, that the estimate for foundations should in every case be rather in excess than too low, as unforeseen contingencies are likely to present themselves.

15. The whole width of the river-bed at the dam site is 510 feet. The dam will cross it at right angles, the centre portion for the height of 434 feet being straight, and the ends curved in the direction of the proposed channels. From the extremity of each of the curves a flank-wall will be carried up the bank to prevent injury of the channel by high floods. On the left bank the flank-wall will be carried on till it runs into the rocky bank; but on the right, as the ground is lower, the flank-wall will be partly replaced by an earthen embankment. The height of the walls above the crest of the dam is 18 feet, or 3 feet above the greatest height the river can rise, assuming the flood of 1853 to be the highest that can possibly occur.

16. In 1853 the water of the river attained a height of 25 feet above the lowest point in the section, and my calculations show an afflux due to the dam and flank walls of 5 feet more, making 30 feet the greatest depth of water that any flood can occasion.

17. The ends of the dam are provided with scouring sluices, that will have the effect of carrying off all deposit that may come down in flood, and keep the entrance of the channel clear. The head of the channel is also under the control of a sluice, that will of course be shut on the approach of a flood in the river. I propose that the dam should be built of uncoursed rubble on the inside and hammer-squared work on the down stream side: all the best stones will be set aside for that part of the work. The estimate for the dam and head sluices is Rs. 12,965.

The Channels.

18. Both the right and left bank channels will be of the same dimensions and shape. The latter has been laid out on the ground at the rate of 2 feet 6 inches to the mile; but this will most probably be altered when the work comes to be carried out. It will, I anticipate, be advisable to increase the inclination, as well as to diminish the section, at every mile after the third. Both channels will be carried for the first three miles at a uniform section of discharge, namely, 17·5 square feet, any diminution of the section up to the end of the third mile being unnecessary, as the amount of land lying between the channels and the river is small, and the expenditure of water will consequently be inconsiderable.

19. After the third mile the width of the channel will decrease regularly at the rate of 9 inches in every mile, till at the end of the ninth mile the section of discharge will be reduced to 8·5 square feet: the depth of water will continue uniform for all sections at 2 feet. The following are the dimensions of the channel at each mile:—

No. of Miles.	Bottom width.	Top width.	Slopes.	Depth.	Discharge in Cubic Feet per Second.
	ft. in.	ft. in.			ft. in.
1 to 3	5 9	11 9	1½ to 1	2	41 65
4	5 0	11 0	..	..	37 60
5	4 3	10 3	..	..	33 50
6	3 6	9 6	..	..	29 38
7	2 9	8 9	..	..	25 30
8	2 0	8 0	..	..	21 30
9	1 3	7 3	..	..	17 42

20. I would remark here that the line of the channel, as laid down on the ground and levelled over, will probably require some slight alteration. Time did not admit of selecting the line most strictly economical or theoretically correct, nor does it appear advisable that more time should have been devoted to doing so previous to framing

the estimates. Any alteration of the channel or masonry works that may be necessary can be made while the work is in progress without materially affecting the estimate.

21. In most cases I have kept the channel at such a height over nullas as to allow the surface drainage to pass underneath it. This would have been the most desirable in every situation if it were possible, but in every channel the line of slope must intersect some watercourses at an awkward level, leaving no alternative but to allow the drainage to pass into, or rather over the canal.

22. There are on the two channels altogether 42 masonry works, which, with the exception of two, have been provided for in the estimate by general plans. Of these two aqueducts one is of considerable size, namely, five spans of 40 feet each, crossing over a large nulla that falls into the river above Wankeshwur; the other carries the channel over a branch of the same nulla, and consists of six spans of 15 feet. The aqueducts will only differ from each other in the number and span of the arches, the same dimensions holding good for all other parts, the necessary allowances being made for difference of height. Wherever the bed of the nulla is of sound material, the aqueducts will be provided with escapes so as to get rid of any excess of water that may get into the channel after heavy showers.

23. The general drawings (Nos. 1, 2, 3, and 7) are for situations where the line of channel nearly coincides with the highest water in the nulla. They are simple walls across the nulla, and are pierced with sluices that can be opened when it is necessary to get rid of deposit. The channel water will discharge itself into the nulla above the dam and issue at the other side.

24. I now come to the question of the water at our disposal, and the probable return that will be derived from the construction of the works. As I before remarked, the supply during the hot season, or the months of February, March, April, and May, cannot safely be taken at more than 10 cubic feet per second. This amount I have not the slightest doubt may be relied on, and is the most valuable part of the stream's supply. It will serve to raise upwards of 1,000 acres of sugarcane, or such other garden produce as must have irrigation during the whole year round.

25. Your measurements, as well as those taken by me in February last, went to show that 20 cubic feet per second may be taken as the reliable discharge during the cold months. Deducting the 10 cubic feet of perennial supply, we shall then have 10 cubic feet as the supply for the rubbee crops.

26. Since the commencement of the present monsoon I have had observations relative to the discharge of the river taken, and for several days together, during which no rain fell in the valley, the discharge was registered at upwards of 90 cubic feet per second. Let us assume however, in order to leave a safe margin, that the supply during the four monsoon months is at lowest 85 cubic feet per second; this, deducting 20 cubic feet for the perennial and eight months' supplies, gives us 65 feet per second as the monsoon supply.

27. In estimating the return that may be derived from carrying out the work, I will adopt the rates that the Collector of Sattara has determined on, and has communicated in his letter No. 154 of 1863 to your address. He has fixed Rs. 4 as the rate for a perennial supply, Rs. 3 for an eight months' supply, and Rs. 2 for a four months' one. Let us take then—

Perennial irrigation 1,000 acres, at Rs. 4 per acre..	Rs.	4,000
Eight months' supply 2,000 acres, at Rs. 3 per acre.	,,	6,000
Four months' supply 6,500 acres, at Rs. 2 per acre.	,,	13,000
Total....	Rs.	23,000
Deduct for maintenance and repairs at five per-cent on the cost Rs. 1,47,546	,,	7,377
Net return....	Rs.	15,623

28. This return is calculated on the assumption that of the 12,800 acres of land under command of the channels, 9,500 acres, or nearly three-fourths of the whole, will be brought under irrigation. The work done by the perennial supply is taken at 100 acres for every cubic foot per second; that by the eight months' supply at 200 acres per cubic foot, and the monsoon irrigation at 100 acres for every foot of continuous flow.

29. Comparing the above estimate of return from the work with the cost, we find that there will be a return of over ten per-cent on the outlay. The rates of assessment are, however, low compared with those that obtain in Khandeish, and there is every reason to expect that when the cultivators become aware of the value of water they will willingly pay higher than the rates we have assumed. The Collector of Sattara indeed in fixing the rates says that they should at first be very low, and merely suggests them for adoption in the first instance.

I have the honour to be, &c.

A. JACOB,
Assistant Superintending Engineer for Irrigation.

Assist. Suptg. Engineer for Irrigation at Sattara's Office,
Kirkee, 12th August 1863.

List of Plans for the Yerla Irrigation Project; to accompany letter No. 166 *of* 1863. *From* A. JACOB, Esq., *Assistant Superintending Engineer for Irrigation, Sattara, to* Captain J. G. FIFE, *Superintending Engineer.*

Number of Drawing.	Description of Work.
1, 2, 3	Escapes of 1, 2, and 3 openings.
4	Aqueduct one arch of 30 feet span.
5	Aqueduct one arch of 40 feet span.
6	Aqueduct three arches of 20 feet span.
7	Escape of ten openings.
8	Aqueduct 5 spans of 40 feet.
9	Aqueduct 6 spans of 15 feet.
10	Cross sections of channels.
11	Longitudinal sections of channels.
12	Bundara.

A. JACOB,
Assistant Suptg. Engineer for Irrigation.

List of Aqueduct and Escapes for Channel C, Yerla Irrigation Project.

Number.	Mileage.		General Drawing.	Description.
	Miles.	Chains.		
1	..	6	No. 3	Escape of three openings.
2	..	8	„ 3	
3	..	29	„ 6	Three 20 feet arch.
4	..	40	„ 6	
5	..	66	„ 6	
6	1	40	„ 1	Escape of one opening.
7	1	44	„ 3	Escape of three openings.
8	1	71	„ 6	Three 20 feet arch.
9	2	13	„ 6	
10	2	17	„ 7	Escape of ten openings.
11	2	46	„ 4	30 feet arch.
12	3	13	„ 4	
13	3	33	„ 4	
14	3	44	„ 4	
15	4	64	„ 7	Escape of ten openings.
16	5	44	„ 4	30 feet arch.
17	6	68	„ 6	Three 20 feet arch.

A. JACOB,
Assistant Suptg. Engineer for Irrigation.

List of Aqueduct and Escapes for Channel D, Yerla Irrigation Project.

Number.	Mileage.		General Drawing.	Description.
	Miles.	Chains.		
1	..	6	No. 1	Escape of one opening.
2	..	9	„ 1	
3	..	11	„ 1	
4	..	12	„ 1	
5	..	15	„ 1	
6	..	16	„ 3	Escape of three openings.
7	..	17	„ 1	Escape of one opening.
8	..	20	„ 2	Escape of two openings.
9	..	23	„ 4	30 feet arch.
10	..	68	„ 4	
11	..	73	„ 4	
12	1	6	„ 2	Escape of two openings.
13	1	17	„ 1	Escape of one opening.
14	1	37	„ 1	
15	1	41	„ 6	Three 20 feet arch.
16	2	10	„ 6	
17	2	43	„ 3	Escape of three openings 40 feet arch.
18	3	9	„ 5	
19	3	56	„ 3	Escape of three openings.
20	5	19	„ 3	
21	5	26	„ 4	30 feet arch.
22	5	33	Special.	Six 15 feet arch.
23	5	62	Special.	Five 40 feet arch.
24	6	18	No. 5	40 feet arch.
25	6	27	„ 4	30 feet arch.

A. JACOB,
Assistant Suptg. Engineer for Irrigation.

ESTIMATE *framed by* Mr. A. JACOB, *Executive Engineer for Irrigation, Sattara, of the probable Cost of Constructing a Masonry Bundara with Head and Scouring Sluices on the Yerla River at the village of Khadgoon.—Amount Rupees* 15,209.

GENERAL DESCRIPTION.

The total length of the dam to be 538 feet. The foundations to be taken down an average depth of 2 feet 6 inches. The bundara to be eight feet wide at top, diminishing to 6 feet at the ends.

The thickness of the dam will increase by offsets to 14 feet at bottom, giving a mean thickness of 11 feet for a height of 16 feet. Where the dam joins the banks of the river it curves with a radius of 25 feet to facilitate the scouring action of the stream and lead the water into the channel. It will be provided with flanking walls, which will be carried above the line of highest flood, and horizontally into the banks of the river. There will be a scouring sluice at either end of the dam to keep the channel free from silt.

CONSTRUCTION.

Foundations	Rock.
Superstructure	Uncoursed rubble and lime with coursed facing.
Sills of sluices	Dressed stone and lime.
Arching	Dressed stone and lime.

Measurements.

Excavation of Foundation.	Number.	Length.	Breadth.	Depth.	Solid Feet.
Lower course	1	370	14	3·5	18,130
Next course to beginning of curve.	2	32	12	3·5	2,688
First portion of curve	2	8	8	4·5	576
Second portion of curve	2	13	10·5	2	546
Flooring of channel	2	25	13	1·25	812·5
End of curve, including floor of sluice	2	17	6	1·25	255
Flanking wall east side	1	130	4	3·5	1,820
Buttresses to east side	5	5	4	3·5	350
Flanking wall west side	1	30	5·5	4·75	783·75
Buttress	1	5	4	3	60
Wing walls end of west buttress	2	35	4·5	3	945
Under-arches	2	11	7	6	924
Cubic feet Excavation of Foundation....					27,890·25

Superstructure.	Number.	Length.	Breadth.	Depth.	Solid Feet.
Dam centre portion	1	300	11	16	52,800
Portions at end of dam	2	35	10·55	14	10,339
Third portion up to curve	2	32	10	12	7,680
First portion of curve	2	8	8	12	1,536
Second portion of curve	2	27	6	9	2,916
Portion under scouring sluice	2	6	6	4·5	324
Floor of channel up to flank wall	2	15	11·5	3	1,035
Side wall of channel	2	24	2	3	288
Outer abutment of culvert	2	7	3	6	252
Inner abutment of culvert	2	7	2	6	168
Floor of culvert	2	11	7	3	462
Flanking wall right bank	1	30	4·25	18	2,295
Flanking wall left bank	1	130	4·25	12·7	7,016·75
Wing-wall	2	35	3·5	18	4,410
Counterfort	6	14·66	3·5	4	1,231·44
Cubic feet of Superstructure..					92,753·19

Arching.

	Number.	Length.	Breadth.	Depth.	Solid Feet.
		Area.			
Over culvert	2	12	75	13	331·5
Cubic feet of Arching.....					331·5

Centering Stone and Mud.

	Number.	Length.	Breadth.	Depth.	Solid Feet.
		Area.			
Under culvert arches	2	24	34	13	632·84
Cubic feet of Centering.....					632·84

Cut Stonework.

	Number.	Length.	Breadth.	Square Feet.
Sills and frames of sluices.....	2	18	2	72
	2	19	2	76
Square feet of Cut Stone.....				148

Sluice Gates.

	Numbers.
Scouring sluices	2
Channel sluices.....	2
Number of Sluice Gates.....	4

Chunam Plaster.

	Number.	Length.	Breadth.	Square Feet.
Top of dam.....	1	514	10	5,140
Square feet of Plastering.....				5,140

Earthwork.

	Number.	Length.	Mean.	Area.	Cubic Feet.
Embankment right bank	1	155	250	..	38,750
Cubic feet of Earthwork.....					38,750

Abstract.

		Rs.	a.	p.
27,890·25	Cubic feet excavation of foundation at Rs. 2-8 per 100 cubic feet	697	4	0
92,753·19	Cubic feet superstructure at 14 rupees per 100 cubic feet	12,985	6	8
331· 5	Cubic feet arching at 25 rupees per 100 cubic feet	83	0	0
632·84	Cubic feet centering stone and mud at 6 rupees per 100 cubic feet	37	15	8
148	Square feet cut stones at 15 rupees per 100 cubic feet	22	3	2
2	Number of sluice-gates at 25 rupees each	50	0	0
2	Number of sluice-gates at 55 rupees each	110	0	0
5,140	Square feet chunam plaster at 5 rupees per 100 square feet	257	0	0
38,750	Cubic feet earthwork at 10 annas per 100 cubic feet	242	0	0
	Rupees	14,484	13	6
	Add—Contingencies 5 per-cent.....	724	4	0
	Grand Total....Rupees	15,209	1	6

A. JACOB,
Executive Engineer for Irrigation.

ESTIMATE *framed by* Mr. A. JACOB, *Assistant Superintending Engineer for Irrigation, Sattara, of the probable Cost of Excavating two Irrigational Channels at either side of the Yerla River.* —*Amount Rs.* 71,117.

GENERAL DESCRIPTION.

The channels to be of the dimensions shown in the tracing. They will be 5 feet 9 inches wide at bottom and 16 feet 3 inches at top for the first 3 miles, narrowing to the tail at the rate of 9 inches in every mile.

The depth will be uniform at 3 feet 6 inches, and the slope 2 feet 6 inches per mile throughout.

Earthwork quantities in Banks.

Number of Bank.	DISTANCE.		Mean Height.	Mean Sectional Area.	Solid Contents, Cubic Feet.	REMARKS.
	Chains.	Feet.				
1	10	660	2·5	105	69,300	
2	14	924	4·8	189	174,636	
3	5·5	363	5·4	189	68,607	
4	10	660	2·7	105	69,300	
5	3	198	1·5	67	13,266	
6	12	792	5·9	236	186,912	
7	18·5	1,221	4·6	189	230,769	
8	24	1,584	6·4	236	373,824	
9	28	1,848	5·1	184	340,032	
10	23·5	1,551	4·8	184	285,384	
11	22	1,452	2·3	65	94,380	
12	10·5	693	2·3	63	43,659	
13	23 5	1,551	8·0	325	504,075	
14	8.5	561	2·0	62	34,782	
15	12	792	3·4	98	77,616	
16	12	792	4·0	137	108,504	
17	8	528	2·3	60	31,680	
18	25	1,650	3·7	132	217,800	
...	270	17,820	..	50·85	906,147	Sides of channel.
...	4·5	297	..	50·85	15,102	Sides on level ground.
		Total Cubic feet of Bank....			38,45,775	

N.B.—The embankments are calculated up to the level of the bottom of the channel, and the contents of the side banks afterwards added.

Earthwork quantities in Cuttings.

Number of Cuttings.	Distance.		Mean Height.	Mean Sectional Area.	Solid Contents.	Remakrs.
	Chains.	Feet.				
1	10	660	2·4	47·5	31,350	
2	6·5	429	2·5	67·5	28,958	
3	22	1,452	4·1	89·5	129,954	
4	24	1,584	4·8	114·5	181,368	
5	5	330	1·3	31·5	10,395	
6	36	2,376	4·2	89·5	212,652	
7	5	330	1·5	47·5	15,675	
8	15	990	3·5	89·5	88,605	
9	13	858	3·1	67·5	57,915	
10	9	594	5·1	108·0	64,152	
11	9	594	1·0	29·0	17,226	
12	12	792	2·6	56·5	44,748	
13	36	2,376	3·1	56·5	134,244	
14	7·5	495	2·6	54 0	26,730	
15	10 5	693	4·2	73·0	50,589	
16	18·5	1,221	3·2	54·0	65,934	
17	30	1,980	2·6	49·5	98,010	
18	8·5	561	1·5	34·5	19,354	
19	24	1,584	6·1	109·0	172,656	
		Total Cubic feet of Cutting....			14,50,515	....

Earthwork quantities in Banks.

Number of Bank.	Distance.		Mean Height.	Mean Sectional Area.	Solid Contents.	Remarks.
	Chains.	Feet.				
1	11	726	1·8	67	48,642	
2	13·5	891	4·1	145	129,195	
3	14	924	2·2	67	61,908	
4	16	1,056	6·3	236	249,216	
5	20	1,320	3·3	105	138,600	
6	4·5	297	3·0	105	31,185	
7	34	2,244	4·2	141	316,404	
8	43	2,838	3·6	141	400,158	
9	20·5	1,353	5·0	183	247,599	
10	35	2,310	2·7	98	226,380	
11	56	3,696	6·5	224	827,904	
12	8·5	561	2·5	93	52,173	
..	276	18,216	..	50·85	926,283	Sides of channel.
..	13	858	..	50·85	43,629	Sides on level ground.
			Total Cubic feet of Bank		3,699,276	

Earthwork quantities in Cuttings.

Number of Cuttings.	Distance.		Mean Height.	Mean Sectional Area.	Solid Contents.	Remarks.
	Chains.	Feet.				
1	6	396	1·7	47·5	18,810	
2	20	1,320	3·5	89·5	118,140	
3	37	2,442	4·3	89·5	218,559	
4	25	1,650	3·5	89·5	147,675	
5	19·5	1,287	4·2	89·5	115,186	
6	24	1,584	2·8	67·5	106,920	
7	23	1,518	4·8	108	163,944	
8	28	1,848	1·7	39·5	72,996	
9	26	1,716	3·8	76·5	131,274	
10	17	1,122	5·8	95	106,590	
11	115·5	3,234 4,389	4·3	68·5 64	502,425	
12	25·5	1,683	4·8	82·5	138,847	
		Total Cubic feet of Cutting.....			1,841,366	

N. B.—Cutting No. 11 is calculated in two portions—3,234 running feet of it are calculated according to the section given for the seventh mile, and 4,389 running feet according to section for the eighth mile.

A. JACOB,
Assistant Suptg. Engineer for Irrigation.

Abstract.

		Rs.	a.	p.
3,845,775	Cubic feet of Bank in Channel C, at 10 annas per 100 cubic feet.....	24,036	1	6
1,450,515	Cubic feet of Cuttings in Channel C, at 10 annas per 100 cubic feet.....	9,065	11	6
3,699,276	Cubic feet of Banks in Channel D, at 10 annas per 100 cubic feet.....	23,120	7	7
1,841,366	Cubic feet of Cuttings in Channel D, at 10 annas per 100 cubic feet.....	11,508	8	7
	Rupees	67,730	13	2
	Add—Contingencies at 5 per-cent	3,386	8	7
	Total....Rupees	71,117	0	0

A. JACOB,
Assistant Suptg. Engineer for Irrigation.

ESTIMATE *framed* by Mr. A. JACOB, *Assistant Superintending Engineer for Irrigation, of the probable Cost of Constructing a Masonry Escape of one opening according to General Drawing No.* 1, *Yerla Irrigation Works.—Amount Rs.* 86.

GENERAL DESCRIPTION.

The Escape to have one opening or sluice gate 2 feet wide by 3½ feet deep, each opening being 3 feet deep. The wall of escape to be continued 3 feet beyond sluice, with its crest at the same level as crest of sluice. Beyond this point the wing-wall to be carried with a thickness of one foot 15 feet into the bank of canal 3 feet higher than crest of sluice or 2 feet higher than flood level. The sluice wall to be 2 feet thick. The foundations of sluice wall to be 3 feet deep. An apron to be placed on outer side of sluice 4 feet wide and 1 foot deep.

CONSTRUCTION.

Foundations and superstructure to be of uncoursed rubble masonry and chunam facing to sides and silts of sluices, to be of third sort cut-stone.

MEASUREMENTS.

Excavating Foundations.	Number.	Length.	Breadth.	Depth.	Total Feet.
Sluice-wall	1	14	2·5	3·5	122·50
Wing-walls.....	2	12	1·5	7	252·00
Apron	1	14	4	2·5	140·00
Total Cubic feet Excavation of Foundations....					514·50

Filling in Foundations.

	Number.	Length.	Breadth.	Depth.	Total Feet.
Sluice-wall	1	14	2·5	3·5	122·50
Wing-walls	2	3	1·5	2	18·00
Do. do.	2	3	1	1	6·00
Apron	1	14	4	1	56·00
Total filling in Foundations....					202·50

Superstructure.

	Number.	Length.	Breadth.	Depth.	Total Feet.
Sluice-wall	1	12	2	3·5	84·00
Do.	2	3	2	1·5	18·00
Wing-walls	2	3	1·5	7	63·00
Do.	2	9	1	7	126·00
Total Cubic feet of Superstructure....					291·00

Cut-stone Work.

	Number.	Length.	Breadth.	Depth.	Total Feet.
Facing sides and silts of sluices ..	1	9	2	..	18·00
Total Cut-stone work....					18·00

Wood Work.

	Number.	Length.	Breadth.	Depth.	Total Feet.
Gates to sluices	1	4	2·5	2″5	2·08
Total Wood work....					2·08

ABSTRACT.

		Rs.	a.	p.
514·5	Cubic feet Excavation, at 12 annas per 100 cubic feet	3	13	9
202·5	Cubic feet Filling Foundation, at 12 rupees per 100 cubic feet	24	4	10
291·00	Cubic feet Superstructure, at 14 rupees per 100 cubic feet	40	11	10
18 00	Superficial feet Cut-Stone work, at 25 rupees per 100 square feet.....	4	8	0
2·08	Cubic feet Teakwood, at Rs. 4 per cubic foot ..	8	5	1
	Rupees	81	11	6
	Added 5 per-cent....	4	1	4
	Grand Total....Rupees	86	0	10

A. JACOB,

Assistant Suptg. Engineer for Irrigation.

ESTIMATE *framed by* Mr. A. JACOB, *Assistant Superintending Engineer for Irrigation, of the probable Cost of Constructing a Masonry Escape of two openings according to General Drawing No. 2, Yerla Irrigation Works.—Amount Rs.* 111.

GENERAL DESCRIPTION.

The Escape to have two openings or sluice-gates 2 feet wide by 3 feet deep, each opening being 3 feet apart. The wall of Escape to be continued 3 feet beyond sluice, with its crest at the same level as the crest of sluice. Beyond that point the wing-wall to be carried with a thickness of one foot 15 feet into the bank of canal 3 feet higher than crest of sluice or 2 feet higher than flood level. The sluice-wall to be 2 feet thick. The foundations of sluice-wall to be $3\frac{1}{2}$ feet deep. An apron to be placed on outer side of sluice 4 feet wide and 1 foot deep.

Construction.

Foundations and Superstructure to be of uncoursed rubble masonry and chunam; facing to sides and silts of sluices to be of third sort cut-stone.

MEASUREMENTS.

Excavating Foundations.	Number.	Length.	Breadth.	Depth.	Total Feet.
Sluice-wall	1	19	2·5	3·5	166·25
Wing do.	2	12	1·5	7	252·00
Apron	1	19	4	2·5	190·00
Total Cubic feet of Excavation..					608·25

Filling in Foundations.	Number.	Length.	Breadth.	Depth.	Total Feet.*
Sluice-wall	1	19	2·5	3·5	166·25
Wing do.	2	3	1·5	2	18·00
Do. do.	2	3	1	1	6·00
Aprons..	1	19	4	1	76·00
Total Cubic feet of filling in Foundations....					266·25

Superstructure.	Number.	Length.	Breadth.	Depth.	Total Feet.
Sluice-wall	1	15	2	3·5	105·00
Do. do	2	3	2	1·5	18·00
Wing-walls	2	3	1·5	7	63·00
Do. do	2	9	1	7	126·00
Total Cubic feet of Superstructure..					312·00

Cut-stone Work.	Number.	Length.	Breadth.	Depth.	Total Feet.
Facing of sides and silts of sluices..	2	9	2	..	36
Total Square feet of Cut-stone work....					36

Wood Work.	Number.	Length.	Breadth.	Depth.	Total Feet.
Gates to sluices	2	4	2·5	2·5	4·16
Total Cubic feet of Wood-work....					4·16

ABSTRACT.

		Rs.	a.	p.
608·25	Cubic feet of excavating Foundation, at 12 annas per 100 cubic feet	4	8	11
266·25	Cubic feet filling in Foundations, at 12 rupees per 100 cubic feet	31	15	2
312·00	Cubic feet Superstructure, at 14 rupees per 100 cubic feet	43	10	10
36·00	Square feet Cut-stone work, at 25 rupees per 100 square feet	9	0	0
4·16	Teakwood Shutters, at 4 rupees each cubic foot.	16	10	3
	Rupees	105	13	2
	Add—Contingencies at 5 per-cent....	5	4	8
	Total....Rupees	111	0	0

A JACOB,
Assistant Suptg. Engineer for Irrigation.

ESTIMATE *framed by* Mr. A. JACOB, *Assistant Superintending Engineer for Irrigation, Sattara, of the probable Cost of Constructing an Escape of three openings according to General Drawing No.* 3, *Yerla Irrigation Works.—Amount Rs.* 136.

GENERAL DESCRIPTION.

The Escape to have three openings or sluice-gates 2 feet wide by $3\frac{1}{2}$ feet deep, each opening being 3 feet apart. The wall of Escape to be continued 3 feet beyond sluices, with its crest at the same level as crest of sluices. Beyond that point the wing-wall to be carried with a thickness of 1 foot 15 feet into the bank of canal 3 feet higher than crest of sluice or 2 feet above flood level. The sluice-wall to be 2 feet thick. The foundations of sluice-wall to be $3\frac{1}{2}$ feet deep. Apron to be placed on outer side of sluice 4 feet wide and 1 foot deep.

CONSTRUCTION.

Foundations and Superstructure to be of uncoursed rubble masonry, and chunam facing to wall; sides and silts of sluices to be of third sort cut-stone.

MEASUREMENTS.

Excavating Foundations.	Number.	Length.	Breadth.	Depth.	Total Feet.
Sluice-wall	1	24	2·5	3·5	210·00
Wing-walls	2	12	1·5	7	252·00
Apron	1	24	4	2·5	240·00
Cubic feet of excavating Foundations....					702·00

Filling in Foundations.	Number.	Length.	Breadth.	Depth.	Total Feet.
Sluice-wall	1	24	2·5	3·5	210·00
Wing-walls	2	3	1·5	2	18·00
Do.	2	3	1	1	6·00
Apron	1	24	4	1	96·00
Total Cubic feet of filling in Foundation....					330·00

Superstructure.	Number.	Length.	Breadth.	Depth.	Total Feet.
Sluice-wall	1	18	2	3·5	126·00
Do.	2	3	2	1·5	18·00
Wing-walls	2	3	1·5	7	63·00
Do.	2	9	1	7	126·00
Total Cubic feet of Superstructure....					333·00

Cut-stone Work.	Number.	Length.	Breadth.	Depth.	Total Feet.
Facings of sides and silts of sluices.	3	9	2	..	54
Total Square feet of Cut-stone work....					54

Wood Work.	Number.	Length.	Breadth.	Depth.	Total Feet.
Gates of sluices	3	4	2·5	2·2	6·52
Total Cubic feet of Wood-work....					6·52

ABSTRACT.

		Rs.	*a.*	*p.*
702	Cubic feet Excavation, at 12 annas per 100 cubic feet	5	4	3
330	Cubic feet filling Foundation, at 12 rupees per 100 cubic feet	39	9	7
333	Cubic feet Superstructure, at 14 rupees per 100 cubic feet	46	9	11
54	Square feet Cut-stone work, at 25 rupees per 100 square feet	13	8	0
6·25	Cubic feet Wood-work, at 4 rupees per foot	25	0	0
	Rupees	129	15	9
	Add—Contingencies at 5 per-cent....	6	8	0
	Total.....Rupees	136	0	0

A. JACOB,

Assistant Suptg. Engineer for Irrigation.

ESTIMATE *framed by* Mr. A. JACOB, *Assistant Superintending Engineer for Irrigation, Sattara, of the probable Cost of Constructing an Aqueduct of one arch of* 30 *feet span on the Yerla Irrigation Works in the Sattara districts.—Amount Rs.* 1,769.

GENERAL DESCRIPTION.

The Aqueduct to consist of one segmental arch of 30 feet span and $7\frac{1}{2}$ rise arch ring to be 1′ 9″ thick. The abutments to have a thickness at base of 5′ 6″ battering, at the rate of 1 in 4 at the back. The backing to be carried up to the level of the entrados; wing-wall to be carried 20 feet into the canal banks with a curve, and to have a butted on the inner side of 1 in 4.

CONSTRUCTION.

Excavation of Foundation..Moorum.
Filling Foundation.....Uncoursed rubble and chunam.
Superstructure.....Coursed rubble and chunam.
Arching .....Slabs set in chunam.
Centering.....Stone and mud.

MEASUREMENTS.

Excavation.	Number.	Length.	Breadth.	Depth.	Solid Feet.
Abutments.....	2	6·5	5·5	4·5	321·75
Wings, lower part	4	9	5·5	8·5	1,683·00
Do. upper part	4	11	3·5	5	770·00
Newels	4	2	2	5·5	88·00
Total Cubic feet of Excavation....					2,862·75

Filling in Foundation.	Number.	Length.	Breadth.	Depth.	Solid Feet.
Abutments	2	8	5	3	240
Wings, lower portion	4	9	4 5	5	810
Do. upper portion	4	11	2·5	3	330
Newels	4	2	2	4	64
Total Cubic feet filling in Foundation					1,444

Superstructure.	Number.	Length.	Breadth.	Depth.	Solid Feet.
Abutments	2	8	4	11	704
Wing walls, lower part	4	9	3	20	2,160
Do. upper part	4	11	2	11	968
Newels	4	2	2	7	112
Spandril spaces	4	48	2	..	384
Parapet, high portion	4	5·5	1·5	4	132
Do. lower portion	2	20	1·5	1·5	90
Total Cubic feet of Superstructure					4,550

Backing.	Number.	Length.	Breadth.	Depth.	Solid Feet.
Backing over arches	2	45·5		5	455
Total Cubic feet of Backing					455

Concrete.	Number.	Length.	Breadth.	Depth.	Solid Feet.
Concrete in bottom of Channel	1	34	6	·5	102
Total Cubic feet of Concrete					102

Arching.

	Number.	Length.	Breadth.	Depth.	Solid Feet.
		Area.			
Arching	1	64	,,	9	576
Cubic feet of Arching					576

String Course.

	Number.	Length.	Running Feet.
String course	1	68	68
Running feet of String Course			68

Blocking Course.

	Number.	Length.	Running Feet.
Blocking course	1	26	26
Running feet of Blocking Course			26

Coping.

	Number.	Length.	Running Feet.
Coping over parapet wings	2	72	144
Running feet of Coping			144

Centering.

	Number.	Length.	Breadth.	Depth.	Solid Feet.
		Area.			
Stone and mud	1	255·57		9	2,300
Cubic feet of Centering....					2,300

Newels.

	Number.
Newels caps	4
	4

Plastering.

	Number.	Length.	Breadth.	Square Feet.
Chunam plaster	1	34	6	204
Square feet of Plastering...				204

ABSTRACT.

		Rs.	a.	p.
2,863	Cubic feet Excavation in moorum, at 12 annas per 100 cubic feet	21	7	6
1,444	Cubic feet Filling Foundation, at 12 rupees per 100 cubic feet	173	4	5
4,550	Cubic feet Superstructure, at Rs. 14 per do. ..	637	0	0
455	Do. Backing, at Rs. 12 per 100 cubic feet.	54	9	7
576	Do. Arching, at Rs. 25 per do. ..	144	0	0
102	Do. Concrete, at Rs. 10 per do. ..	10	3	2
2300	Do. Stone and Mud Centering, at Rs. 6 per 100 cubic feet.	138	0	0
68	Running feet String Course, at 2 rupees per 1 running foot.....	136	0	0
26	Do. Blocking, at Rs. 2 per do.	52	0	0
144	Do. Coping to Parapet, at Rs. 2 per do.	288	0	0
4	Newels Caps, at 5 rupees each	20	0	0
....	Starling Caps	.....		
204	Square feet Plastering at 5 rupees per 100 square feet	10	3	2
	Rupees	1,684	11	10
	Add—Contingencies 5 per-cent....	84	3	4
	Total....Rupees	1,769	0	0

A. JACOB,
Assistant Suptg. Engineer for Irrigation.

ESTIMATE *framed* by Mr. A. JACOB, *Assistant Superintending Engineer for Irrigation, Sattara, of the probable Cost of Constructing an Aqueduct of* 40 *feet span on the Yerla Irrigation works in the Sattara districts.—Amount Rs.* 2,171.

GENERAL DESCRIPTION.

The Aqueduct to consist of one span of 40 feet with a rise of 10 feet Arching to be 2′ 3″ thick. The abutments to have a thickness at base of 7 feet; battering at the rate of 1 in 4 at the back. The backing of the arch to be carried up level with the extrados of the arch. The wings to be curved and carried 20 feet into the channel bank, battering at the back at the rate of 1 in 4. Parapets to be 4′ 3″ high at the ends and 2 feet in the centre, with a thickness throughout of 1′ 6.″

CONSTRUCTION.

Foundations.....Moorum.
Superstructure.....Coursed rubble.
Filling Foundations.....Uncoursed rubble.
Arching .....Slabs set in chunam.
Newels Caps, Blocking, and
Springing Course .....Roughly dressed.

MEASUREMENTS.

Excavation.	Number.	Length.	Breadth.	Depth.	Solid Feet.
Abutments	2	7	7	4	392
Wings, lower part	4	10	6	10	2,400
Do. upper part	4	11	3·5	5·5	847
Newels	4	2	2	6	96
Cubic feet of Excavation.....					3,735

Filling Foundations.	Number.	Length.	Breadth.	Depth.	Solid Feet.
Abutments	2	7	7	2	196
Wings, lower part	4	10	5·25	6	1,260
Do. upper part	4	11	3·25	4	572
Newels	4	2	2	4	64
Cubic feet of Filling Foundations....					2,092

Superstructure.	Number.	Length.	Breadth.	Depth.	Solid Feet.
Abuments	2	5·25	7	12	882
Wings, inner portions	4	10	3·5	16	2,240
Do. end portions	4	11	1·75	8	616
Newels	4	2	2	8	128
		Area			
Spandril spaces	4	77	....	1·5	462
Parapet walls, ends	4	5	1·5	4 25	12·57
Do. do. middle part	2	30	1·5	2	180
Cubic feet of Superstructure....					4,635·5

Backing.	Number.	Length.	Breadth.	Depth.	Solid Feet.
Backing over arches	2	$\frac{24 \times 3{\cdot}25}{2}$		6	468
Cubic feet of Backing....					468

Arching.

	Number.	Length.	Breadth.	Depth.	Solid Feet.
		Area.			
Arching	1	109·5		9	985·5
Cubic feet of Arching....					985·5

Centering.

	Number.	Length.	Breadth.	Depth.	Solid Feet.
		Area.			
Stone and mud	1	429·6		9	3,866·4
Cubic feet of Centering....					3,866·4

String Course.

	Number.	Length.	Running Feet.
String course	..	..	88
Running feet of String Course....			88

Springing Course.

	Number.	Length.	Running Feet.
Springing course	..	..	26
Running feet of Springing Course....			26

Newels.

	Number.
Newels caps	4
	4

Concrete.

	Number.	Length.	Breadth.	Depth.	Solid Feet.
Concrete in bottom of channel	1	48	6	·5	144
Cubic feet of Concrete					144

Plastering.

	Number.	Length.	Breadth.	Square Feet.
Bottom of channel	1	48	6	288
Square feet of Plastering				288

Coping.

	Number.	Length.	Running Feet.
Parapet and wing walls	2	82	164
Running feet of Coping			164

ABSTRACT.

		Rs.	a.	p.
3,735	Cubic feet Excavation, at 12 annas per 100 cubic feet	28	0	2
2,092	Cubic feet Filling Foundation, at 12 rupees per 100 cubic feet	251	0	7
4,635·5	Cubic feet Superstructure, at 14 rupees per 100 cubic feet	648	15	6
468	Cubic feet Backing, at 12 rupees per 100 cubic feet	56	2	6
985·5	Cubic feet Arching, at 25 rupees per 100 cubic feet	246	6	0
3,866·4	Cubic feet Centering Stone and Mud, at 6 rupees per 100 cubic feet.....	231	15	8
88	Running feet String Course, at 2 rupees per 1 running foot	176	0	0
26	Running feet Springing Course, at 2 rupees per 1 running foot	52	0	0
164	Running feet Coping, at 2 rupees per 1 running foot	328	0	0
144	Cubic feet Concrete, at 10 rupees per 100 cubic feet	14	6	4
288	Square feet Plastering, at 5 rupees per 100 square feet	14	6	4
4	Newels Caps, at 5 rupees each	20	0	0
	Rupees	2,067	5	1
	Add—Contingencies 5 per-cent....	103	5	10
	Total... Rupees	2,171	0	0

A. JACOB,
Assistant Suptg. Engineer for Irrigation.

ESTIMATE *framed by* Mr. A. JACOB, *Assistant Superintending Engineer for Irrigation, Sattara, of the probable expense for Constructing an Aqueduct of three Arches of* 20 *feet span each on the Yerla Irrigation works in Sattara Districts.—Amount Rs.* 3,261.

GENERAL DESCRIPTION.

The Aqueduct to consist of three segmental arches of 20 feet span each, with a rise of 5 feet. Arch ring to be 1 foot 3 inches thick. The abutments to have a thickness at base of 5 feet 6 inches, battering at the rate of 1 in 4 at the back. The backing to be carried up level with the extrados of the arches. The wing-walls to be carried 25 feet into the bank of channel with a curve. Parapet-walls to be 4 feet 3 inches high at the ends and 1 foot 9 inches at centre, the thickness throughout being 1 foot 6 inches.

CONSTRUCTION.

Excavation of Foundations..Moorum.
Filling Foundations .....Uncoursed rubble and chunam.
Superstructure.....Coursed rubble and chunam.
Arching .....Slabs set in chunam.
Centering.....Stone and mud.

MEASUREMENTS.

Excavation.	Number.	Length.	Breadth.	Depth.	Solid Feet.
		Area.			
Piers	2	39·02		2·5	195·1
Abutments.....	2	6·5	5·5	8	572·0
Wings, lower part.....	4	9	5 5	12	2,376 0
Do. upper part	4	11	3·5	7	1,078·0
Newels	4	2	2	7·5	120·0
				Cubic feet of Excavation....	4,341·1

Filling Foundations.

	Number.	Length.	Breadth.	Depth.	Solid Feet.
		Area.			
Piers	2	39·02		2	156·08
Abutments	2	6·5	5	5	325·00
Wings, lower portion	4	9	4·5	9	1,458·00
Do. upper portion	4	11	2·5	4	440·00
Newels	4	2	2	6·5	104·00
Cubic feet Filling Foundations....					2,483·08

Superstructure.

	Number.	Length.	Breadth.	Depth.	Solid Feet.
		Area.			
Piers	2	39·02		7	546·28
Abutments	2	9	3·5	8	504·00
Wing-walls, lower part	4	10	2·5	11	1,100·00
Do. upper part	4	10	2	7	560·00
Newels	4	2	2	4·5	72·00
Spandrils	6	51	15	1·5	6,885 00
Parapet, high portion	4	10	1·5	4	240·00
Do. lower portion	2	47	1·5	1·5	211·05
Cubic feet of Superstructure....					10,118·78

Backing.

	Number.	Length.	Breadth.	Depth.	Solid Feet.
		Area.			
Backing over arches	3	51	6	..	918
Cubic feet of Backing....					918

Concrete.

	Number.	Length.	Breadth.	Depth.	Solid Feet.
		Area.			
Concrete in bottom of channel....	1	74	6	·5	222
Cubic feet of Concrete....					222

Arching.

	Number.	Length.	Breadth.	Depth.	Solid Feet.
		Area.			
Arching	3	36·81		9	993·87
Cubic feet of Arching....					993·87

String Course.

	Number.	Length.	Running Feet.
String course	1	88	88
Running feet of String Course....			88

Blocking Course.

	Number.	Length.	Running Feet.
Blocking course.....	1	31	31
Running feet of Blocking Course....			31

Newels.

	Number.
Newels caps	4
	4

Coping.

	Number.	Length.	Running Feet.
Coping of parapet and wings	2	110	220
Running feet of Coping			220

Starling.

	Number.
Starling caps	2
	2

Centering.

	Number.	Length.	Breadth.	Depth.	Solid Feet.
Of stone and mud	..	..	..	..	3,958·33
Cubic feet of Centering					3,958·33

Plastering.	Number.	Length.	Breadth.	Square Feet.
Of chunam	1	74	6	444
Square feet of Plastering....				444

ABSTRACT.

		Rs.	*a.*	*p.*
4,341	Cubic feet Excavation, at 12 annas per 100 cubic feet	32	8	11
2,483	Cubic feet Filling Foundation, at 12 rupees per 100 cubic feet	297	15	4
10,119	Cubic feet Superstructure, at 14 rupees per 100 cubic feet	1,416	10	6
918	Cubic feet Backing, at 12 rupees per 100 cubic feet	110	2	6
994	Cubic feet Arching, at 25 rupees per 100 cubic feet	248	8	0
222	Cubic feet Concrete, at 10 rupees per 100 cubic feet	22	3	2
88	Running feet String Course, at 2 rupees per 1 running foot	176	0	0
31	Running feet Blocking, at 2 rupees per 1 running foot	62	0	0
220	Running feet Coping to Parapet, at 2 rupees per 1 running foot	440	0	0
4	Newels Caps, at 5 rupees each	20	0	0
2	Starling Caps, at 10 rupees each.....	20	0	0
3,958	Cubic feet Centering Stone and Mud, at 6 rupees per 100 cubic feet.....	237	7	8
444	Square feet Plastering, at 5 rupees per 100 square feet	22	3	2
	Rupees	3,105	11	3.
	Add—Contingencies 5 per-cent....	155	4	6
	Total....Rupees	3,261	0	0

A. JACOB,
Assistant Suptg. Engineer for Irrigation.

ESTIMATE *framed* by Mr. A. JACOB, *Assistant Superintending Engineer for Irrigation, Sattara, of the probable Cost of Erecting a Masonry Escape according to General Drawing No. 7, Yerla Irrigation works in the Sattara districts.—Amount Rs.* 1,267.

GENERAL DESCRIPTION.

The Escape to be 108 feet long, and will consist of an overfall weir pierced with 10 rectangular openings 3′ × 3′ each. These openings to be provided with shutters to close them in heavy freshes. The height of the Escape will be 10 feet, with a mean thickness of 3′6″ vertical on the lower face and slopped on the upper. The foundations will be protected by an apron 120 feet long by 10 feet wide and 2 feet thick.

CONSTRUCTION.

Foundations.....Mann or indurated clay.
Superstructure.....Uncoursed rubble.
Sills of Openings.....Dressed stone.
Shutters .....Teak plank.

MEASUREMENTS.

Excavation.	Number.	Length.	Breadth.	Depth.	Solid Feet.
Lower course.....	1	100	4·5	2·0	900·0
Second do.	1	120	4·5	1·75	945·0
Apron	1	120	10·0	1·75	2,100·0
Third course	1	100	4·5	1·25	562·5
Fourth do.	1	34	4·5	2·0	306·0
End portions	2	12	2·5	3·0	180·0
Do. do.	2	10	4·0	1·0	80·0
			Cubic feet of Excavation....		5,073·5

Superstructure.	Number.	Length.	Breadth.	Depth.	Solid Feet.
Lower course	1	100	4·5	2·0	900
Second do.	1	120	4·0	2·0	960
Apron	1	120	10·0	2·0	2,400
Third course	1	140	3·5	2·0	980
Fourth do.	1	140	3·0	1·75	735
Do. end portions	2	10	1·0	2·0	40
Portions between openings	9	6	2·5	2·0	270
Ends of same course	2	28	2·5	2·0	280
Wings of escape	2	18	2·5	4·0	360
Do. ends	2	10	1·0	6·0	120
Cubic feet of Superstructure					7,045

Dressed Stone.	Number.	Length.	Breadth.	Square Feet.
Sills for shutters	10	9	1	90
Square feet of Dressed Stone				90

Chunam Plaster.	Number.	Length.	Breadth.	Square Feet.
Crest of escape	1	110	3·5	385
Square feet of Plastering				385

Shutters.	Number.
Teakwood shutters	10
	10

ABSTRACT.

		Rs.	a.	p.
5,073·5	Cubic feet Excavation, at 12 annas per 100 cubic feet.....	38	0	9
7,045	Cubic feet Superstructure, at 14 rupees per 100 cubic feet.....	986	4	9
90	Square feet Dressed Stone, at 15 rupees per 100 square feet	13	8	0
385	Square feet Plastering, at 5 rupees per 100 square feet	19	4	0
10	Teakwood Shutters, at 15 rupees each	150	0	0
	Rupees	1,207	1	6
	Add—Contingencies 5 per-cent....	60	5	7
	Total....Rupees	1,267	0	0

A. JACOB,
Assistant Suptg. Engineer for Irrigation.

No. 1 OF 1863-64.

SATTARA COLLECTORATE. { III.—Public Improvements. K.—Agricultural. I.—Irrigation Canals.

ESTIMATE *framed by* Mr. A. JACOB, *Assistant Superintending Engineer for Irrigation, Sattara, of the probable Expense for Constructing an Aqueduct of five Arches of* 40 *feet span each on the Yerla Irrigation works in the Sattara districts.—Amount Rs.* 7,806.

GENERAL DESCRIPTION.

The Aqueduct to consist of five segmental arches of 40 feet span and 8 feet rise. Arch ring to be 2 feet 6 inches thcik. The abutments to have a thickness at base of 7 feet; battering at the rate of 1 in 4 at the back. The backing of the arches to be carried up level with the extrados of arches. The wing-walls to be carried 25 feet into the bank of the channel, with a splay of $1\frac{1}{2}'$ to 1′, and to batter on the face at 1′ in 6′. Parapet-walls to be 4 feet 3 inches high at the ends and 2 feet at centre, the thickness throughout being 1 foot 6 inches.

Construction.

Excavation of Foundations..Rock
Filling Foundations.....Uncoursed rubble and chunam.
Superstructure.....Coursed rubble and chunam.
Arching .....Slabs set in chunam.
Centering.....Stone and mud.
Coping String Course and
Springing Course. .....To be chisel-drafted.

Measurements.

Excavation.	Number.	Length.	Breadth.	Depth.	Solid Feet.
Piers		Area.			
Abutments.....	4	85·5		1·75	598·5
Wing-walls.....	2	5	7·0	2·5	175·0
	4	28	7·5	3·5	2,940·0
			Cubic feet of Excavation....		3,713·5

Excavation in Earth.	Number.	Length.	Breadth.	Depth.	Solid Feet.
Abutments.....	1	5	7·0	3·5	122·5
Wing-walls.....	4	28	7·5	5·5	4,620·0
			Excavation in Earth....		4,742·5

Filling Foundations.	Number.	Length.	Breadth.	Depth.	Solid Feet.
Abutment	1	5·0	6·5	4	130·0
Wing-walls	2	28·5	6·6	6	2,257·2
Filling Foundations....					2,387·2

Superstructure.	Number.	Length.	Breadth.	Depth.	Solid Feet.
		Area.			
Piers	4	85·5		9·25	3,163·5
Wing-walls	2	29	4·0	14·0	3,248·0
Do.	2	29	5·0	20·0	5,800·0
		Area 157·5			
Spandrels	10	15	7·5	1·5	2,362·5
Parapet, high portion	4	72	1·5	4·0	1,728·0
Do. low portion	2	94	1·5	2·75	775·5
Cubic feet of Superstructure....					17,077·5

Concrete.	Number.	Length.	Breadth.	Depth.	Solid Feet.
Concrete in bottom of channel	1	236	6	0 5	708
Cubic feet of Concrete....					708

Backing.

	Number.	Length.	Breadth.	Depth.	Solid Feet.
		Area.			
Backing over arches.....	5	157·5		6	4,725
Cubic feet of Backing....					4,725

Arching.

	Number.	Length.	Breadth.	Depth.	Solid Feet.
		Area.			
Archings.....	5	114·45		9	5,150·25
Cubic feet of Arching....					5,150·25

String Course.

	Number.	Length.	Running Feet.
String course	2	236	472
Running feet of String Course....			472

Springing Course.

	Length.	Running Feet.
Springing course	186	186
Running feet of Springing Course....		186

10557

Starling Caps.

	Number.
Starling caps	4
	4

Centering.

	Number.	Length.	Breadth.	Depth.	Solid Feet.
Of stone and mud	..	..	..	..	22,458
Cubic feet of Centering....					22,458

Coping.

	Number.	Length.	Breadth.	Depth.	Solid Feet.
To parapet chisel-drafted	..	..	..	..	..
					..

ABSTRACT.

		Rs. a. p.
3,713·5	Cubic feet Excavation in rock, at Rs. 2-8 per 100 cubic feet	92 13 4
4,742·5	Cubic feet Excavation in earth, at 12 annas per 100 cubic feet	35 9 1
2,387·2	Cubic feet Filling Foundation, at 12 rupees per 100 cubic feet	286 7 5
17,077·5	Cubic feet Superstructure, at 14 rupees per 100 cubic feet.....	2,390 13 7
4,725·0	Cubic feet Backing, at 12 rupees per 100 cubic feet	567 0 0
5,150·25	Cubic feet Arching, at 25 rupees per 100 cubic feet	1,287 9 0
708·0	Cubic feet Concrete, at 10 rupees per 100 cubic feet	70 12 9
22,458·0	Cubic feet Stone and Mud Centering, at 6 rupees per 100 cubic feet	1,347 7 8
472·0	Running feet String Course, at 2 rupees per 1 running foot.....	944 0 0
186·0	Running feet Blocking, at 2 rupees per 1 running foot	372 0 0
..	Running feet Coping to Parapets, at per 100 running feet	....
4·0	Starling Caps, at 10 rupees each	40 0 0
	Rupees	7,434 8 10
	Add—Contingencies 5 per-cent....	371 11 7
	Total....Rupees	7,806 0 0

A. JACOB,
Assistant Suptg. Engineer for Irrigation.

ESTIMATE *framed by* Mr. A. JACOB, *Assistant Superintending Engineer for Irrigation, Sattara, of the probable Cost of Constructing an Aqueduct of six Arches of* 15 *feet span each on the Yerla Irrigation works in the Sattara districts.—Amount* Rs. 3,100.

GENERAL DESCRIPTION.

The Aqueduct to consist of six segmental arches of 15 feet span each and 4 feet rise. Arch ring to 1 foot 6 inches thick. The abutment to have a thickness of 4 feet. Backing of the arches to be brought up level with the extrados. Wing-walls to be carried 18 feet into the canal bank, with a splay of $1\frac{1}{2}$ to 1. Batter on the face 1 in 8. Parapet to be 4 feet 3 inches high.

CONSTRUCTION.

Excavation of Foundation ..Gravel and moorum.
Filling Foundation .....Uncoursed rubble.
Superstructure .....Coursed rubble.
Arching .....Slabs set in chunam.
Centering.....Stone and mud.
String Course and Springing Course ..... Roughly dressed stone.

MEASUREMENTS.

Excavation in Gravel.	Number.	Length.	Breadth.	Depth.	Solid Feet.
Piers	5	14·0	5·5	7·6	2,926·0
Abutments .....North	1	8·7	6·5	6·5	367·57
Do. .....South	1	8·7	6·5	6·25	353·43
Wing-walls .....North	2	19·0	5·5	8·0	1,672.00
Do. .....South	2	19·0	5·5	11·5	2,403·5
				Cubic feet of Excavation....	7,722·5

Excavation in Moorum.	Number.	Length.	Breadth.	Depth.	Solid Feet.
Piers	5	14	5·5	1·3	500·5
Abutments	2	8·7	6·5	2	226·2
Wing-walls	4	19	5·5	2·25	940·5
Cubic feet of Excavation....					1,667·2

Filling Foundation.	Number.	Length.	Breadth.	Depth.	Solid Feet.
Piers footings	5	12	4·5	2	540
Do. upper portion	5	11	3	5·5	907·5
Abutments footings	2	8·7	5·5	2	191·4
Do. upper portion	2	8·7	4	6	417·6
Wing-walls footings	4	18·75	5·25	2	787·5
Do. upper portion	4	18	3·86	6·25	1,737·0
Cubic feet of Filling Foundation....					4,581

Superstructure.	Number.	Length.	Breadth.	Depth.	Solid Feet.
Piers	5	11	3	5·5	907·5
Wing-walls	4	18	2·5	8·25	1,485·00
Spandrels	12	Area. 35		1·5	630·00
Parapets	2	113	1·5	4·25	1,440·75
Cubic feet of Superstructure....					4,463·25

Arching.

	Number.	Length.	Breadth.	Depth.	Solid Feet.
Arching	6	19·16	9	1·5	1,552
Cubic feet of Arching.....					1,552

Backing.

	Number.	Length.	Breadth.	Depth.	Solid Feet.
		Area.			
Backing over arches.....	6	25		6	900
					900

Concrete.

	Number.	Length.	Breadth.	Depth.	Solid Feet.
In bottom of channel	1	114	6	0·5	34
Cubic feet of Concrete....					342

Springing Course.

	Number.	Length.	Running Feet.
Springing Course	..	..	168
Running feet of Springing Course.....			168

String Course.

	Number.	Length.	Running Feet.
String Course	..	..	221
Running feet of String Course			221

Plastering.

	Number.	Length.	Breadth.	Square Feet.
Chunam plastering	..	117	6	702
Square fee of Plastering				702

Starling Caps.

	Number.
Starling caps	5
	5

Centering.

	Number.	Length.	Breadth.	Depth.	Solid Feet.
Of stone and mud	..	..	..	..	5,239
Cubic feet of Centering					5,239

ABSTRACT.

		Rs.	a.	p.
7,722·5	Cubic feet Excavation of Foundation in Gravel, at 12 annas per 100 cubic feet	57	14	8
1,667·2	Cubic feet in Moorum, at Rs. 12 per 100 cubic feet	12	8	0
4,581	Cubic feet Filling Foundation, at Rs. 12 per 100 cubic feet	549	11	6
4,463·25	Cubic feet Superstructure, at Rs. 14 per 100 cubic feet.....	624	13	8
1,552	Cubic feet Arching, at Rs. 25 per 100 cubic feet.	388	0	0
900	Cubic feet Backing, at Rs. 12 per 100 cubic feet.	108	0	0
342	Cubic feet Concrete, at Rs. 10 per 100 cubic feet.	34	3	2
168	Running feet Springing Course, at Rs. 2 per 1 foot.....	336	0	0
221	Running feet String Course, at Rs. 2 per 1 foot.	442	0	0
702	Square feet Chunam Plastering, at Rs. 5 per 100 square feet	35	1	7
5	Starling Caps, at Rs. 10 each.....	50	0	0
5,239	Cubic feet Centering Stone and Mud, at Rs. 6 per 100 cubic feet	314	5	5
	Rupees	2,952	10	0
	Add—Contingencies 5 per-cent....	147	6	0
	Total....Rupees	3,100	0	0

A. JACOB,
Assistant Suptg. Engineer for Irrigation.

Recapitulation.

Number	Name of Work.	Amount.			Total.		
	Right Bank Channel.	*Rs.*	*a.*	*p.*	*Rs.*	*a.*	*p.*
	Earthwork	34,756	14	5	34,756	14	5
1	Escape General Drawing No. 1..at	86	0	2	86	0	2
3	Do. do. do. No. 3..at	136	7	9	409	7	3
5	Aqueduct do. do. No. 4..at	1,768	15	0	8,844	11	0
6	Do. do. do. No. 6..at	3,261	0	2	19,566	1	0
2	Escape do. do. No. 7..at	1,270	14	0	2,541	12	0
	Left Bank Channel.						
8	Escapes General Drawing No. 1..at	86	0	2	688	1	4
2	Do. do. do. No. 2..at	111	2	8	222	5	4
4	Do. do. do. No. 3..at	136	7	9	545	15	0
5	Aqueduct do. do. No. 4..at	1,768	15	0	8,844	11	0
2	Do. do. do. No. 5..at	2,170	14	0	4,341	12	0
2	Do. do. do. No. 6..at	3,261	0	2	6,522	0	4
1	Do. Special do. No. 8..at	7,806	0	0	7,806	0	0
1	Do. do. do. No. 9..at	3,100	4	2	3,100	4	2
	Earthwork	36,373	9	4	36,373	9	4
1	Bundara, with head-works, flanking-walls, &c. complete.....	15,209	0	0	15,209	0	0
	Total Estimate for the construction of a Bundara and two Irrigation Channels on the Yerla River				1,49,859	0	0

A. JACOB,
Executive Engineer for Irrigation.

J. G. FIFE, Captain,
Superintending Engineer for Irrigation.

No. 362 of 1863.

Public Works Department.

To the Revenue Commissioner S. D., Poona.

Sir,—I have the honour to forward a Report, with Plans, and Estimates amounting to Rs. 1,49,644, by Mr. Jacob, the Executive Engineer for Irrigation in the Sattara Collectorate, for the first section of a series of works it is proposed to carry out in the Yerla Valley.

2. Our attention was drawn to the Yerla Valley last season by the Collector as greatly demanding irrigation on account of the smallness and precariousness of the rainfall, and a list of proposals for small dams and irrigating channels was forwarded to us. This led to an examination of the valley by Mr. Jacob and myself, and the drawing up of a general plan of Irrigation, comprising all the works suggested to us, which proved satisfactory on inquiry, and providing for works to increase the River Yerla's perennial supply. This general plan is described by Mr. Jacob in his report. It is only necessary for me therefore to mention that it consists of a storage lake near the village of Nehr, and four or more sets of distributing works at intervals down the valley. With the exception of a short period employed in making a general examination for irrigational facilities in the Maun River and Neera River valleys, Mr. Jacob's whole time and that of the small establishment at his disposal has been devoted to the working out of the Yerla project.

3. Being the first season of the department, however, the whole of the work was not brought to quite a satisfactory conclusion. The distributing works have caused no difficulty, but the survey for the storage lake did not give us very satisfactory results, and there was not leisure for further investigation before out-door operations were interrupted by the monsoon. One of the difficulties in the lake was caused by the ground proving favourable only for the formation of a larger basin than the drainage during a season of less than average rainfall is likely to fill. During a year of drought therefore our lake would not fill, and considering that one of the objects of irrigation

works is to secure the country against drought and famine, the point is of more importance than a mere question of expense. Doubts have been expressed as to the rainfall guage on which our calculations are based, fairly representing the fall that may be relied upon at the head of the Yerla Valley, which is high and mountainous. I feel little doubt myself that the fall at the head of the valley is greater than that at Khanapoor, where the rain-guage has been kept for some years. This point is now being tested by the placing of another guage about the centre of the area that will drain into the proposed lake. In the meantime, however, I cannot of course submit the large project we contemplate. Further survey will be requisite before we can feel sure that we have arrived at the best means of storing water. The principle on which storage works should be made is certainly that they should ensure a full supply of water during a season of drought. Storage works so designed will also pay the best because during ordinary seasons they will be oftener replenished. I believe that by going furthur down the valley we shall obtain a site for a lake, not presenting, perhaps, such apparent facilities as that near Nehr, but really much more valuable from receiving the drainage of a larger area of country.

4. In the meantime Mr. Jacob has prepared a plan and estimate for a weir and two small distributing channels near Khatgoon to use up the present supply in the Yerla. These works have been selected from a great many for which surveys were made on account of their presenting the greatest facilities for construction, and I beg to recommend them for the sanction of Government. This section of works is complete in itself, and its execution will in no way affect the ultimate carrying out of the other works proposed.

5. The project has been carefully prepared, and I approve of it generally. I have appended some remarks to the estimate on certain details of construction which can be modified when the work is carried out. The alterations so slightly affect the cost that I have not thought it desirable to employ the time of Mr. Jacob and his establishment in preparing fresh plans.

6. The cost of the work is estimated after correction at Rupees 1,49,644, and the annual return at Rupees 15,623, or about 10·44

per-cent. I believe this will be deemed sufficiently remunerative. I should, however, mention that the rates recommended to be charged per acre by Mr. Chapman, the Collector, are really only about one-fourth as respects perennial, and one-half as respects rubbee and monsoon crops, of the rates willingly paid by the people in Khandeish. If the Khandeish rates be applied the return will become as follows:—

1,000 acres of perennial Irrigation, at 16 rupees per acre ..... Rs.	16,000
2,000 acres of eight months' Irrigation, at 6 rupees per acre	12,000
6,500 acres of four months' Irrigation, at 4 rupees per acre	26,000
	54,000
Deduct 5 per-cent per annum on outlay of Rupees 1,49,644 for maintenance and establishment	7,482
Annual Return.... Rs.	46,518

This would be at the rate of 31·08 per-cent on the outlay.

7. I have not made these remarks with the view of disputing the wisdom of fixing low rates (a point on which I believe Mr. Chapman is perfectly right, as the people will be thus encouraged to use the water directly it is supplied), but merely to show that the real value of the project to the country is at least three times as great as those rates indicate, as proved by what the people in Khandeish actually willingly pay under similar circumstances.

8. If the project is sanctioned before the working season commences, one lakh of rupees may be advantageously expended upon it during the current year.

9. No chowky has been provided in the estimate for stores and for the shelter of the establishment during inclement weather. Such shelter is absolutely necessary to enable an officer or subordinate to visit the works at any season to correct anything that may be wrong both during the execution of the work and afterwards when it is brought into operation. The estimated cost of a chowky according

to plans lately submitted for Khandeish is Rs. 970, which should be added to the estimate for Rs. 1,49,644 now submitted, making a total of Rs. 1,50,614 to be sanctioned.

I have the honour to be, &c.

J. G. FIFE, Captain,
Superintending Engineer for Irrigation.

Office of the Superintending Engineer for Irrigation,
Kirkee, 13th August 1863.

REMARKS ON CONSTRUCTION.

The dam may be reduced in thickness till the mean thickness is equal to half the height.

2. The screen-walls at the heads of the channels may be reduced in thickness by one foot. The retaining-wall on the river side of each channel to be raised to act as a butress to the screen-wall and assist in keeping out floods.

3. The parapets of the aqueducts generally to be increased in thickness by one foot. The retaining-wall in escapes to be similarly increased in thickness at the deep point in each section.

4. The wing-walls of the aqueducts to be carried back from the abutments without a recess.

5. Cut-stone coping is provided for the aqueduct parapets, but a rounded coping of chunam plaster should be substituted as being, if anything, more serviceable than ordinary cut-stone work and much cheaper. The inside of parapets to be chunam-plastered to prevent leakage. A beam should be thrown across the entrance and tail of each aqueduct to prevent cattle crossing.

J. G. FIFE, Captain,
Superintending Engineer for Irrigation.

No. 2588 OF 1863.

PURLIC WORKS DEPARTMENT.

From the REVENUE COMMISSIONER S. D.,

To the SECRETARY TO GOVERNMENT.

SIR,—I have the honuor to submit herewith for the consideration of Government a letter from Captain Fife, Superintending Engineer for Irrigation, No 362, dated 13th August 1863, with its accompaniments, proposing the immediate commencement of an irrigational work of much importance in the Khuttao talooka of the Sattara collectorate.

2. If Government are satisfied with the proposed project in a scientific point of view, as I have no doubt they will be, though I can offer no opinion on its professional details, I hope they may be able to provide for the expenditure to which sanction is solicited by Captain Fife for the work which he proposes to accomplish in the current year. In the meanwhile I shall request Captain Fife to obtain from the Collector, if he should not have already done so, as accurate an account as can be obtained of the nature, ownership, and other particulars of the 12,800 acres of land which will become irrigable on the completion of the portion now proposed as a section of the more extensive project to be hereafter matured.

I have the honour to be, &c.

W. HART,

Revenue Commissioner S. D.

Poona, 15*th August* 1863.

No. 1026 of 1863.

Public Works Department.

Memorandum.

Referred to the Superintending Engineer Southern Division for his opinion and report on the engineering details and on the estimates.

2. The project should be returned with the Superintending Engineer's remarks with the least possible delay.

M. K. KENNEDY, Lieut. Colonel, R.E.,
Secretary to Government.

Bombay Castle, 20th August 1863.

No. 4766 of 1863.

Public Works Department.

To the Secretary to Government, Public Works Department.

Sir,—With reference to your memorandum No 1026 of the 20th instant, I have the honour to remark on the Yerla Irrigation Project as follows.

2. From the experiments on evaporation taken by Lieutenant Colonel (now Major General) Scott, then the Superintending Engineer Central Province, on tanks in the Poona and Khandeish districts, it appears that the mean evaporation in a day of twenty-four hours was half an inch. This proves that ten feet depth of water evaporates during eight months, while Mr. Jacob assumes to be eight feet.

3. Again, in paragraphs 27 and 28 of Mr. Jacob's letter he assumes that one cubic foot of water for eight months' suppy is sufficient for 200 acres, and the same quantity of water for four months' (in the monsoon) supply is sufficient for 100 acres, which evidently appears a mistake, as during four months of rain the supply of water is not so much required as in next four months of dry season. Mr. Jacob assumes the quantity of water for the monsoon double that of the dry

season. If the first assumption be true, a larger quantity of land could be irrigated during monsoon by extending the channels with a little more outlay.

4 The estimate is correct enough to give the outside cost of the project.

5. I concur with Captain Fife in his remarks on the construction of dam and aqueducts.

6 Plans and estimates are herewith returned.

I have the honour to be, &c.

GORE MUNBEE, Colonel,

Poona, 31*st August* 1863. Superintending Engineer S. D.

No. 6356 OF 1863.

PUBLIC WORKS DEPARTMENT.

To the SECRETARY to GOVERNMENT, Public Works Department.

SIR,—I have the honour to forward herewith a project received from Captain Fife for Irrigation from the Yerla river.

2. The weir has been altered as suggested in Lieutenant Colonel Kennedy's memorandum, dated the 21st September 1863.

3. The remarks made in my letter No. 5219 of 24th September 1863, with reference to the abutments of bridges and thickness of aprons, apply equally to the scheme now under consideration, but as very few masonry works have to be built, the project need not, perhaps, be returned for further alteration, as the amount of contingencies will much more than cover any extra expense required to be incurred on that account.

I have the honour to be, &c.

C. SCOTT, Lieut. Colonel,

Superintending Engineer S. D.

Office of Superintending Engineer S. D.,

Poona, 11*th November* 1863.

No. 276 OF 1864.

PUBLIC WORKS DEPARTMENT.

Letter from the Superintending Engineer Southern Division, No. 6356, dated 11th November 1863—Submits Plans and an Estimate, the latter amounting to Rs. 1,49,859, for Irrigating from the Yerla River in the Sattara Collectorate.

RESOLUTION.—The project to be sanctioned for consideration when the Budget for 1864-65 is being prepared.

2. The Superintending Engineer Southern Division should furnish Lieut. Colonel Fife with a memorandum of his remarks on the various details of construction referred to in his 3rd paragraph, and those points should be attended to during the progress of the work.

M. K. KENNEDY, Lieut. Colonel, R.E.,
Secretary to Government.

Bombay Castle, 17*th February* 1864.

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PLAN
OF THE
PROPOSED
SYSTEM of IRRIGATION
FOR THE
YERLA RIVER
Scale 2 miles to an Inch.
KHETTAW
Nerle
Rámshungúsh
Retirements
Length of Channel Cash Miles &c &c
Their Black Line
(Signed) A. Jacob
Assist. Engr.
Insp. Gen. Irrigation

GENERAL PLAN OF ESCAPES FOR CHANNELLING THE YERLA R R

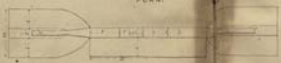
Scale of 40 feet to an Inch

ELEVATION.

No. 3.

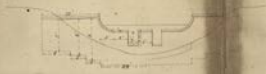
For 3 Sluices on Channels C & D.

PLAN.



CROSS SECTION.

ELEVATION.

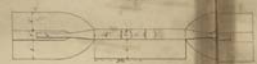


(Signed) A. Smith Asst.
Superintending Engineer
for Irrigation.

No 2.

For 2 Sluices on Channels B

PLAN.



CROSS SECTION.

Designed, Drawn and Lithographed by Capt. J.G. Fitz and Mr. A. Smith Assts. Engineers.

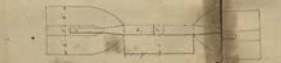
ELEVATION.

(Signed) J. G. Fitz. Captain
Superintending Engineer
for Irrigation.

No 1.

For 3 Sluices on Channels C.D.

PLAN.



CROSS SECTION.

GENERAL DRAWING Nº 4.

CHANNELS C & D.

For 10 Nullas on both Channels.

PLAN

Foundations

Superstructure

SECTION AT A B.

ELEVAT

Designed drawn and Estimated by
M. A. Jacob, Executive Engineer.

Scale of ... to an Inch.

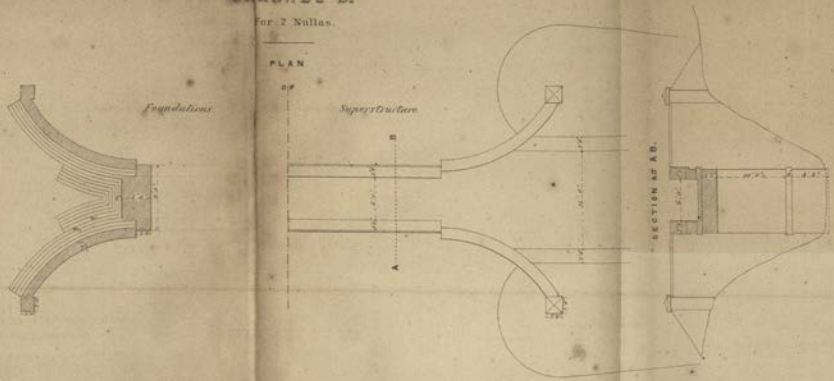
(Signed) J. G. Fife, Captain
Supdt Engr for Irrigation.

(Signed) A. Jacob.
Asstt Supdt Engr
for Irrigation.

GENERAL DRAWING Nº 5.

CHANNEL D.

for 2 Nullas.



Designed, Drawn, and Estimated by
Mr. A. Jacob, Executive Engineer.

Scale of 10 Feet to an Inch.

(Signed.) J. G. Fife, Captain,
Superintending Engineer.

(Signed.) A. Jacob, Asst.
Supt. Engr. for Irrigation.

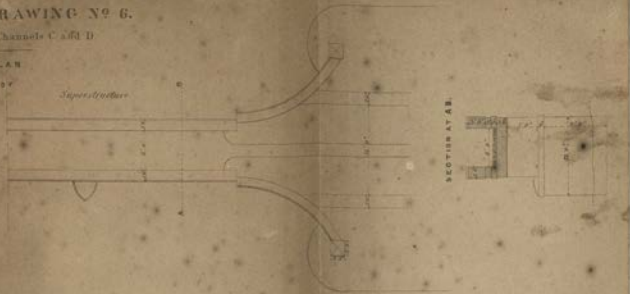
GENERAL DRAWING Nº 6.

For 8 Arches on Channels C and D

PLAN

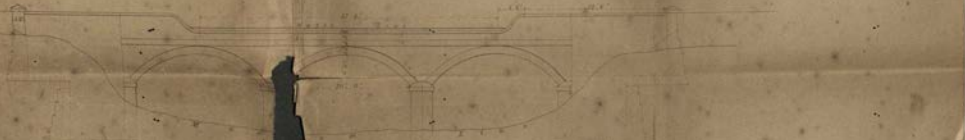
of

Superstructure



SECTION AT AB.

ELEVATION



Surveyed, Drawn, Lithographed by
Mr. A. Leech, Executive Engineer

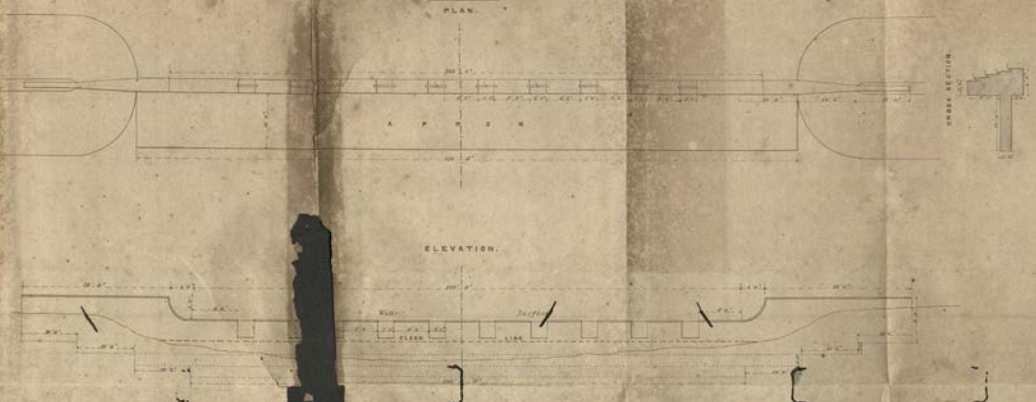
Mr. W. Fort, Assist.

Examined, J. C. Fife, Engineer
Superintending Engr. for Irrigation

Signed: A. Leech, Executive
Superintending Engr. for Irrigation

GENERAL DRAWING Nº 7.

For 2 Nullas on Channel C.



Prepared drawn and Illustrated by
Mr. A. Storck, Executive Engineer.

Scale of 10 Feet to an Inch.

Signed: J. C. Fyfe, Captain,
Staff Engineer for Irrigation.

Signed: A Storck Asst
Staff Engr for Irrigation.

PLAN OF AQUEDUCT FOR NULLA. AT

W. Co. 5 33

CHANNEL D.

Plan of Foundations.

Plan of Superstructure.

SECTION on A.B.

ELEVATION.

Scale 10 Feet to an inch.

Designed, Drawn & Estimated by
Mr A. Jacob Ex Engr

Superintending Engr for Irrigation.

Engrs A. Jacob Assistt Engr for Irrigation.

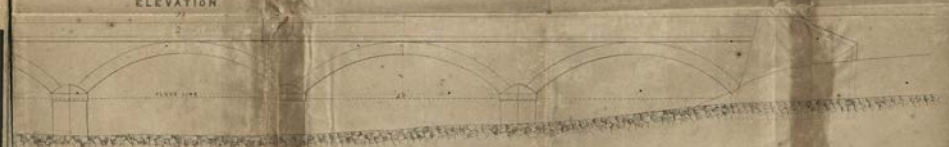
PLAN
OF
AQUEDUCT
OVER
NULA
AT
Plan at Foundations
Plan at Superstructure
ELEVATION
Scale 20 Feet to an Inch
Designed Drawn & Executed by
Mr. A. Jacob
Civil Engineer

PLAN
OF
AQUEDUCT
ON
NULA

CHANNEL. D.

SECTION ON AB

ELEVATION



Scale 20 feet to an Inch.

Designed, Drawn & Constructed by
Mr A. Jacob
Ex Engineer

Approved
H. R. Pitt, Captain
Superintending Engineer
for Irrigation

Examined
A. Smith
Assistt Inspr Genl
for Irrigation

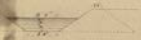
CROSS SECTIONS
of
CHANNELS
on the
YERLA RIVER.

Cross Section for the first 3 Miles

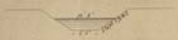
Cross Section 4th Mile

Scale of 30 Feet to an Inch

Cross Section 2nd Mile



Cross Section 3rd Mile



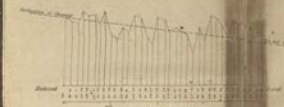
Cross Section 5th Mile

Cross Section 6th Mile

Cross Section 7th Mile

(Signed) J. G. Fife, Captain
Supdt Engineer for Irrigation

(Signed) A. Jacob Assistant
Supdt Engineer for Irrigation



CHANNEL A.
From Nhar Right Bank.

CHANNEL C.
From Khaliperwal Right Bank.

CHANNEL E
From Wardankarar Right Bank.

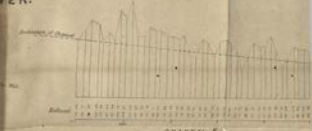
SECOND

IRRIGATION CHANNEL

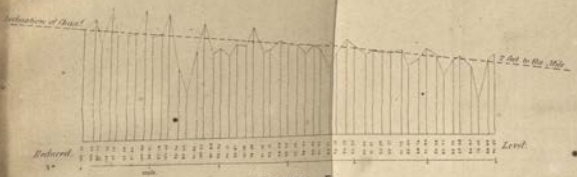
YERLA RIVER.

CHANNEL B.
From Nhar Left Bank.

CHANNEL D.
From Khaliperwal Left Bank.

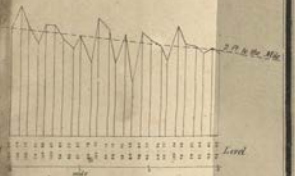


CHANNEL F.
From Wardankarar Left Bank.



CHANNEL. E.

From Wunkeshwur Right Bank.



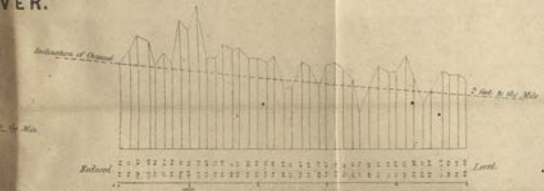
CHANNEL. G.

From Nadwul-Left Bank.

ONS

CHANNEL.

IVER.



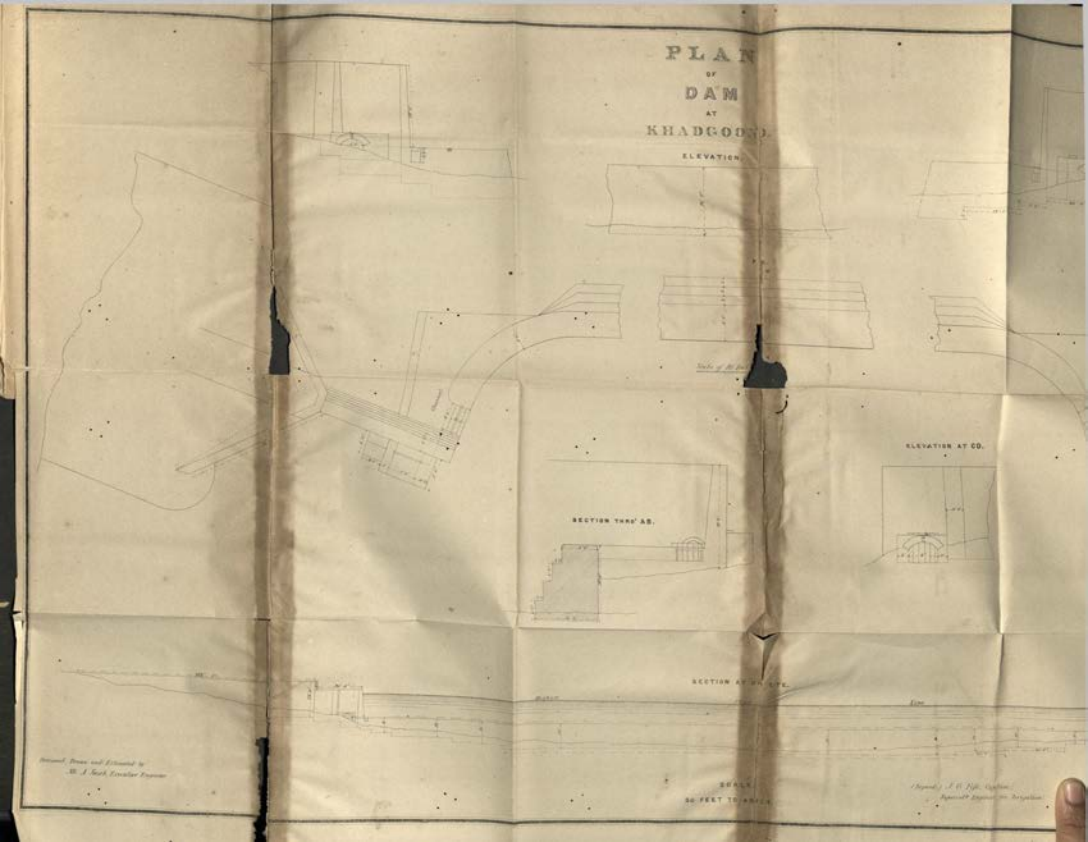
CHANNEL. F.

From Wunkeshwur Left Bank.

(Signed) J. G. Fife. captain
Superintending Engineer
for Irrigation.

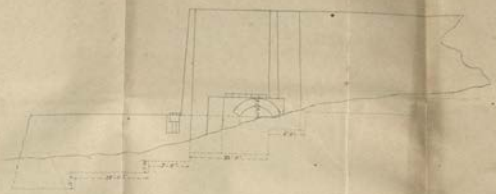
Signed A. Jacob.
Assistant Sup.ᵗᵉ Engr.
for Irrigation.

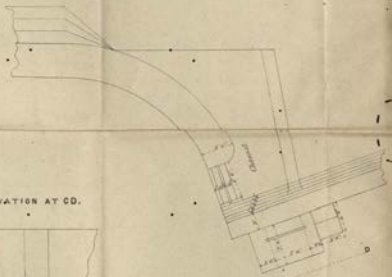
PLAN
OF
DAM
AT
KHADGOON.



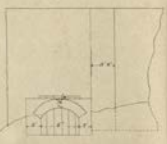
PLAN
OF
DAM
AT
KHADGOON.

ELEVATION.

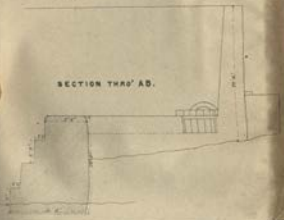


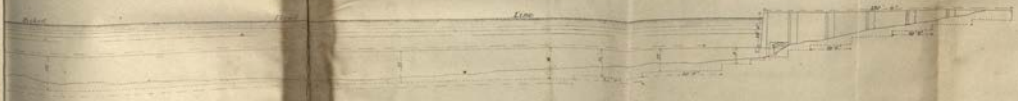


ELEVATION AT CD.



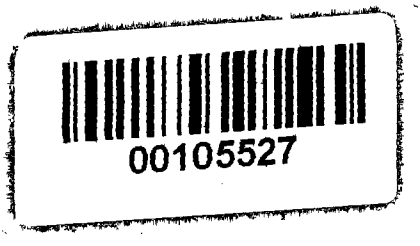
SECTION THRO' AB.



SECTION AT DAM SITE.

SCALE
30 FEET TO AN INCH

(Signed) J. G. Fife, Captain
Superintending Engineer for Irrigation

(Signed) A. Jacob, Assistant
Superintending Engineer
for Irrigation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